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The Long-Run Impacts of Adult Deaths on Older Household Members in Tanzania

Achyuta R. Adhvaryu
Kathleen Beegle

The World Bank
Development Research Group
Poverty and Inequality Team
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Abstract

HIV/AIDS is drastically changing the demographic landscape in high-prevalence countries in Africa. The prime-age adult population bears the majority of the mortality burden. These "missing" prime-age adults have implications for the socioeconomic well-being of surviving family members. This study uses a 13-year panel from Tanzania to examine the impacts of prime-age mortality on the time use and health outcomes of older adults, with a focus on long-run impacts and gender dimensions. Prime-age deaths are weakly associated with increases in working hours of older women when the deceased adult was co-resident in the household. The association is strongest when the deceased adult was living with the elderly individual at the time of death and for deaths in the distant past, suggesting that shorter-run studies may not capture the full extent of the consequences of adult mortality for survivors. Holding more assets seems to buffer older adults from having to work more after these shocks. Most health indicators are not worse for older adults when a prime-age household member died, although more distant adult deaths are associated with an increased probability of acute illness for the surviving elderly. For deaths of children who were not residing with their parents at baseline, the findings show no impact on hours worked or health outcomes.

This paper—a product of the Poverty and Inequality Team, Development Research Group—is part of a larger effort in the department to understand the socioeconomic impact of HIV/AIDS. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at kbeegle@worldbank.org.

The Long-Run Impacts of Adult Deaths on Older Household Members in Tanzania[1]

Achyuta R. Adhvaryu
Yale University

Kathleen Beegle
The World Bank

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1. Introduction

The HIV/AIDS epidemic in Sub-Saharan Africa has resulted in higher mortality rates among prime-age adults and sharp declines in life expectancy. The resulting "demographic hourglass" due to missing working-age adults has implications for a range of socioeconomic outcomes. These missing working-age adults were income earners who supported dependent children and, in some cases, their older parents. A World Bank (1997) report presents a detailed discussion of the direct and indirect ways in which an HIV/AIDS death may affect households and the means by which households might cope with these impacts.

Empirical research in this area in the African context focuses largely on the impact of HIV/AIDS-related deaths on the outcomes of orphaned or fostered children specifically, or households generally (see studies reviewed in Beegle and De Weerdt, 2008, and Naidu and Harris, 2005). There are far fewer studies on the impact of prime-age deaths on older populations specifically. Qualitative studies suggest that the impact could be large for older persons (Knodel *et al.* 2003; Knodel and Landingham 2002). There are important aspects of direct and indirect effects of prime-age mortality specific to older adults (see discussion in du Guerny, 2002, and Messkoub, 2008). Surviving parents often bear the direct costs for ill adult children, including funeral and medical expenditures; indirect costs borne by the elderly include those associated with providing care to ill adult children, fostering-in of grandchildren, and the loss of remittances and income.[2] In addition to these socioeconomic outcomes, there are potential psycho-social costs associated with losing a child or other household members.

There may be important gender dimensions to these impacts on older adults, as well, with respect to the gender of the older adult as well as the gender of the deceased. Gender inequalities in education, income, and property ownership may be important for

[2] The burden of caring for orphaned children is perhaps the most-often cited concern with respect to the elderly and HIV/AIDS epidemic (and rising prime-age mortality rates). Interestingly, even in countries in Africa with low HIV prevalence and/or where orphan rates are not increasing, grandparents are increasing becoming caregivers of children (rather than either a surviving parent or other relatives such as aunts/uncles) (Beegle *et al.* 2009). This fact suggests important changes in living arrangements that are not explained by HIV/AIDS, and which have implications for the well-being of the elderly.

understanding the impact of HIV/AIDS.[3] Women are more likely to be caregivers, both of sick adults as well as children fostered into the household. For example, a survey in South Africa showed that two-thirds of caregivers were women with a third of them above age 60 (Steinberg *et al.* 2002 cited in UNICEF 2004). Gender inequalities in access to off-farm income opportunities make remittance income and (dis)inheritance of assets more salient issues for women. Women in many African settings have less secure rights to land and assets, raising concerns about women being dispossessed of assets when widowed or when another (male) household member dies.

Evidence of such events often comes from case studies; evidence from sample survey efforts is lacking. One exception from Malawi is somewhat contrary to expectations. The national household survey in 2004/05 found that the average value of land and assets lost after a male death in the household was actually lower in the patrilineal North region, where women traditionally have less rights to assets, compared to the South and Central regions (Republic of Malawi and the World Bank 2007). This finding likely reflects rapid changes in national laws and local customs. For example, for the 51 villages in the Tanzania data used in this study, in 1991, 39 percent of village informants reported that the norm in the community allowed a woman to inherit land when her husband dies. In 2004, 86 percent report that this is the norm. While male deaths, including husbands and sons, may be more salient for women than men with respect to assets and income, deaths of prime-age women may matter for non-monetary reasons. Adult daughters are more likely to be caregivers to their elderly parents, making older adults potentially vulnerable to a lack of care if they lose daughters. Combined, the speculation is that faced with the death of a working adult family member, older adults in Africa, especially women, will be left with fewer income sources and assets, will need to work more, and will face greater poverty and poorer health.

Despite well-developed theories about the pathway and speculation of magnitude of impacts (see, for example, Ferreira 2004), there exists little systematic, empirical evidence about the effects of adult death on older household members (Knodel *et al.*

[3] Gender inequalities may also be a driver of the transmission of HIV. The related literature is not discussed here. Likewise, children may be differentially impacted by the loss of their parent along gender lines. Several studies find that maternal mortality impacts schooling more than paternal mortality (Beegle and De Weerdt 2008).

2003). Knodel and co-authors have several studies on the elderly in Cambodia and Thailand; there is much less evidence for Sub-Saharan Africa. The most rigorous sample survey-based evidence arguably comes from South Africa (see, for example, studies in Cohen and Menken 2006).[4] Yet, the combination of the old-age pension scheme which provides cash transfer to older adults and the very severe HIV epidemic suggest that the impacts observed in South Africa may be quite different than impacts in other African countries (Hosegood and Timaeus, 2006).

Moreover, most of these studies focus on demographic impacts (living arrangements, population age/gender structure) rather than more direct measures of economic impacts. A second problem is that many studies in this literature tend to have small, often specially selected samples and be case-based; see, for example, Agyarko (2002) and Ogunmefun (2007). These studies lack discussion of the problems of endogeneity in both living arrangements and mortality events (i.e. deaths do not randomly occur in this context). The existing evidence is usually not longitudinal in nature, thus prohibiting an understanding of "the full impact of HIV/AIDS…assessed over time" (Naidu and Harris, 2005). It is often presumed that studies may understate impacts if households use coping strategies, such as assistance from neighbors or selling off assets, which may mitigate direct impacts on well-being, at least in the short-run (World Bank, 1997). Long-run impacts may differ from evidence drawn from short-run panel data (see, for example, Carter *et al*., 2007, who explore three rounds of a 12-year household panel in South Africa). Furthermore, as noted above, there may be specific gender dimensions (with respect to gender of deceased and gender of survivors) which warrant further study.

The objective of this study is to provide empirical evidence of the impacts of adult deaths on older adults using long-run panel data from Kagera, a region of northwest Tanzania. Using a longitudinal data set covering 13 years, we analyze a sample of individuals who are 50 or older in 2004. The time span of the data allows us to assess long-run impacts of adult death, with particular attention paid to gender dimensions of the surviving older adult and the deceased. We focus on several outcomes. We explore how

[4] Although not focusing specifically on the elderly, in the journal *AIDS* November 2007 volume 21 supplement 7 on "Poverty, HIV and AIDS: Vulnerability and Impact in Southern Africa" 7 of 10 papers are on South Africa, 1 on Zimbabwe, and 2 are cross-country studies.

working hours are impacted by adult deaths; the underlying premise is that prime-age deaths weaken support to older adults, both financial (remittances in cash and in-kind) and through labor sharing in farming and household activities. This, in turn, may result in older adults having to work more to sustain their household. We look for evidence that the impact on work varies by length of time from the death shock and by the asset position of the household prior to the shock. We extend our outcomes to also include more direct measures of well-being, including health and consumption.

Earlier work by Ainsworth and Dayton (2003) and Dayton and Ainsworth (2004) examines the short-run impacts of adult death on the elderly using the first four years of the same panel dataset we use. The authors find that the body mass index (BMI) of older individuals drops just before an adult death but then recovers to the previous level afterwards. We extend the work of these studies by focusing on long-term impacts (up to 13 years after an adult death), and by analyzing changes in labor supply of the elderly in addition to health outcomes. We also construct indicators for prime-age adult mortality which reflect the complexities of household composition. These include measures of co-residency over time and deaths of biological children who may never had resided with the parent at baseline.

We find that prime-age deaths occurring while the deceased adult was living with the elderly respondent are associated with increases in working hours of older women. For older men, labor increases are associated when the deceased was not a household member at the time of the death, but with less precision. The impacts are more pronounced for when the deceased is a younger prime-age (15-29 years) co-residents. For non-co-residents, the labor increase is associated with older prime-age (30-49 years) co-residents. The impacts are mainly for deaths in the distant past, suggesting that shorter-run studies may not capture the full extent of the consequences of adult mortality for survivors. Older adults with greater assets are able to buffer the labor supply response for deaths of co-resident members. Most health indicators were not worse for older adults who experience a death shock in the household (similar to the findings of Ainsworth and Dayton, 2003, and Dayton and Ainsworth, 2004), although more distant deaths were associated with an increased probability of acute illness of surviving adults. We find no impact on hours worked or health of deaths of biological children who were not household members of the older adults at baseline.

The rest of the paper is organized as follows. Section 2 describes the data and defines the key dependent and independent variables. Section 3 lays out our empirical strategy and discusses the various types of bias on the measurement of the impact of adult death. Section 4 presents our results, and Section 5 concludes.

2. Data

2.1. Geographical context and data summary

This study uses survey data from the Kagera region of Tanzania, an area west of Lake Victoria, and bordering Rwanda, Burundi and Uganda. Kagera is mostly rural and primarily engaged in producing bananas and coffee in the north, and rain-fed annual crops (maize, sorghum, and cotton) in the south. The region is an area of early and high HIV prevalence, which has led to a significant increase in prime-age mortality rates. Kwesigabo *et al.* (2005) report on three population samples in 1987 in districts of contrasting exposure in Kagera, and find an overall age-adjusted HIV prevalence of 24.2% in urban Bukoba district; 10.0% in Muleba district, a medium-prevalence area; and 4.5% in Karagwe district, a low-prevalence area.

Subsequently, prevalence rates in the region have dropped rapidly, which has been attributed both to mortality of those infected and lower incidence (as measured by repeat testing of the original population-based sample). In urban Bukoba, prevalence went down to 18.2% in 1993 and 13.3% in 1996. In the other areas studied, prevalence also declined considerably, to 4.3% and 2.6% in Muleba and Karagwe, respectively. Kwesigabo *et al.* (2005) note that the decline in these areas of different initial HIV-exposure suggests that the epidemic may have been arrested early without necessarily peaking to “saturation levels” (in which all people most at risk are infected). Nevertheless, and of relevance to our study, a rapid decline in prevalence, even without a change in the incidence of HIV, is only possible through a high mortality rate in this period.

The Kagera Health and Development Survey (KHDS) was conducted by the World Bank and Muhimbili University College of Health Sciences (MUCHS) and consists of 915 households interviewed up to four times, from fall 1991 to January 1994, at 6 to 7 month intervals (World Bank, 2004). The sample was stratified based on illness and mortality prior to the first round (see World Bank, 2004 for details) and this stratification is controlled for in all regressions. The follow-up, the KHDS 2004, was conducted in the first half of 2004 (Beegle *et al.*, 2006).

2.2. Older adults

We analyze outcomes for the 2004 sample of older individuals who were in the original KHDS baseline interview in 1991.[5] In keeping with the literature on older persons in developing countries, we define older adults as above the age of 50 in 2004; thus, these individuals were as young as 37 years in 1991. 1,060 individuals in the data fall under the category of older adults, as defined here. Of these, 613 are re-interviewed in 2004.

We make note of two things with respect to the sample. First, the youngest of our sample of older individuals (those who were just above 50 years old in 2004) were below 50 years for the majority of the time span we study. Approximately 25% of the sample was below 50 years old at baseline. That is, our sample of "older adults" is actually not so old at baseline. However, give the long span of the data set, we face a tradeoff between two definitions for the sample of older adults: (1) not-so-elderly at baseline and aging into older adult status by 2004, or (2) elderly at baseline and very old (or already deceased) by 2004. We choose to focus on the former definition.

Second, the main cause of attrition in the sample of elderly individuals over the 13-year span of the panel is death. Of the 1,060 individuals at baseline who would have been over 50 in 2004, 403 (38%) died in the thirteen year span of the panel and 44 (4%) were not relocated. We return to this issue below when we explore the correlates of attrition. Of the 613 respondents who were re-interviewed, 87% live in the same community in which they were interviewed 13 years earlier. This age group is much less geographically mobile compared to younger age groups in the KHDS, of which 59% of those re-interviewed live in the same community. Few of the older adults live alone,

[5] Since we are focusing on long-run impacts, we do not use data from the 2nd-4th rounds (collected at roughly 6 month intervals from mid 1992 to late 1993) of the KHDS. Earlier studies, including Ainsworth and Dayton (2003) and Beegle (2005) do explore labor and health impacts using the 4 rounds from 1991 to late 1993.

although the rate does increase from about 3% to 7% by 2004. The average household size of the elderly sample is larger than younger age groups in the KHDS and declines from 6.7 persons to 5 persons over the panel. Most of the 2004 elderly individuals are living with their sons, daughters or grandchildren in 2004 (see Table 1 for a summary of living arrangements for the elderly).

2.3. Adult death

Our main independent variable is a binary variable indicating whether or not there was a prime-age death in the older individual's household between baseline (1991) and 2004. We define "prime age" as ages 15 to 50, inclusive.[6] Since the data set spans thirteen years, the term "household" cannot be well defined. Even though the elderly are less geographically mobile (i.e. are more likely to live in same village than younger respondents), the composition of their household changes over the course of the panel. Of the 613 elderly individuals in 2004, only 84 have a household of the same size, and only 14 live in a household with exactly the same group of panel respondents as at baseline. It is thus clear that living arrangements change for the elderly over the course of the panel (as they do, in fact, for respondents of all ages). These changes reflect life-cycle events like children moving away after marriage, as well as responses to shocks (for example, the fostering in of an orphaned child).

Our variables for adult death must thus take into account the changing nature of the household over time. To this end, we use three indicator variables reflecting different types of adult deaths which can potentially impact the socioeconomic situation of the elderly. The first equals one if all the following conditions are satisfied: 1) the adult who died was of prime age (15-50) at the time of death; 2) the adult was part of the elderly individual's baseline household; and 3) the elderly individual and the prime-age adult were living together at the time of death. We refer to these deaths in our results as "Co-resident PHHM who died ages 15-50," where PHHM stands for previous household member. The majority of these deaths are close relatives of the respondent (spouse, child, sibling, or niece/nephew).

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[6] We do not specifically try to ascertain the cause of death. Rather, we focus on mortality among prime-age adults; other studies have found that a majority of these deaths are caused by HIV/AIDS (Centers for Disease Control and Prevention 2000).

The second binary variable corresponds to the death of a previous household member (i.e., an adult who was living with the elderly individual at baseline in 1991) who was *while living away* from the elderly person at the time of his/her death. We include this group in consideration of the fact that elderly individuals in this region may receive cash or in-kind support from previous household members who later reside in another household. The variable equals one if all the following conditions are satisfied: 1) the adult who died was of prime age (15-50) at the time of death; 2) the adult was part of the elderly individual's baseline household; and 3) the elderly individual and the prime-age adult were *not* living together at the time of death. We refer to this variable in our results as "Non-co-resident PHHM who died ages 15-50."

The third binary variable corresponds to the death of non-co-resident biological children of the elderly at baseline, who again may be important through their monetary support to other household members. We construct a binary variable that equals one if 1) the elderly individual had a non-co-resident child living at baseline who would have been 15-50 in 2004, and 2) at least one such child died between 1991 and 2004. Note that this definition is slightly different from the previous ones, since here, children living elsewhere who died before the age of 15 may still be included if they would have been 15 by 2004.

Due to data restrictions, we omit an important category of prime-age adults in these definitions. An elderly individual may have been living with prime-age adults who died who were not part of the baseline sample; since the retrospective mortality questionnaire in the 2004 survey does not ask about these deaths, they will be omitted from the prime-age death variable defined above. It is possible that we are missing some important events among those who are identified as having experienced none of the three death shocks defined above.

The survey data also record the year in which prime-age individuals died for the first two adult death variables described above. In some analyses, we construct and use binary variables corresponding to the death of a prime-age household member during three periods of the panel: 1991 to 1995, 1996 to 1999, and 2000 to 2004.

2.4. Outcome variables

Our analysis examines several outcome variables related to labor, health, and food consumption. The labor supply variables include: farm hours (includes hours on own farm, hours on community farm, hours processing crops, hours herding, and hours processing livestock); wage employment hours; self-employment hours in non-farm work; hours spent gathering firewood and fetching water; and total hours, which is the sum of hours spent in all categories of work just mentioned. These variables correspond to hours spent in each activity in the 7 days prior to the day the household is surveyed. Labor intensity in rural Africa settings is quite difficult to measure due to the predominance of farming and the seasonality in labor hours. The survey did not try to construct an annual estimate of labor hours. We do not include hours spent in housekeeping and child care, partly because these data will be prone to large measurement error.

The average number of hours worked per week reported in Table 2 is below 30 hours and this may appear low. These numbers are actually quite similar to national survey estimates from neighboring countries. For example, they are similar to the hours for individuals in rural households in the Malawi 2004/05 Integrated Household Survey and the Kenya Integrated Household Budget Survey 2006/07 (results not reported). This can be explained in at least two ways. First, in rural areas the main economic activity is farming which leads to large seasonal variation in labor supply (Cleave, 1974) such that the timing of surveys matters. In both the Kenya and Malawi surveys noted above, the field work is spread over 12 months. In the case of the KHDS, the field work was over about 6 months in the first half of the year, which covers some periods of peak labor demand for the long rainy season but was not conducted solely in that period. High seasonal variation is likely to be less of an issue in Kagera, though, with relatively more continuous cultivation of bananas and coffee than in regions with seasonal farming (those with more prominent bimodal or uni-modal rainy seasons). Second, hours will be low in areas with low land holdings per household member such as Kagera (which may be evidence of surplus labor).

We use the following health outcomes: body mass index (BMI); an indicator for self-reporting of an illness in the four weeks prior to survey; an indicator for chronic illness, which is any current illness that has lasted for more than six months; days of restricted activity due to illness or injury in the week prior to survey; and days of no activity due to illness or injury in the week prior to survey. We also examine food consumption per adult equivalent in the household.[7]

2.5. Controls

We control for the following set of baseline characteristics at the individual and household level: gender, highest grade completed, a quadratic in age, season of interview, assets, household size, the number of children living outside the household, and an indicator for sample enumeration classification (which equals one if the elderly individual's initial household had experienced an illness shock prior to 1991). We also control for the histories of crop and illness shocks in each year over the time span of the panel.

2.6. Summary statistics

Table 2 reports means for dependent and independent variables for four groups: the pooled sample of elderly individuals at baseline, the subsample re-interviewed, and, among those re-interviewed, elderly individuals who did or did not experience a prime-age death in the household.

Comparing the first two columns in Table 2, we find some statistically significant differences between the baseline characteristics of older adults re-interviewed in 2004 and the entire sample (1,060) including those who died. Those re-interviewed were more likely to be female, were younger, worked more, and were healthier in 1991. We address this selective attrition bias using a re-weighting procedure which is described below.

Second, among the 613 older adults we study, we observe some statistically significant differences in baseline characteristics between those who do and those who do not experience a death before 2004 (top half of Table 1, columns 3 and 4). Those who will experience a death are more likely to be women, are doing less farm work and chores

[7] The scale for calculating adult equivalent household size is the same scale used by the Tanzania National Bureau of Statistics for the analysis of poverty using the Household Budget Survey data. It is an adjustment based on the age and gender of household members, where non adult males have weights below 1. It does not account for economies of scale in household consumption.

in 1991, and have more wage employment. The differences we observe at baseline indicate that deaths are not necessarily random events, an issue discussed in more detail below. In 2004, the only significant difference between those who experienced a death shock and those who did not is in body mass index (BMI). Older adults who had a death shock have higher BMI than their counterparts with no death shock.

3. Empirical Strategy

We begin with a basic empirical model of the relationship between elderly outcomes (y) and prime-age death in the household (d). We index elderly individuals by e and (baseline) households by j. The regression is on a cross section of elderly individuals in 2004. We make use of the panel dimension by using the change in the outcome y from 1991 to 2004 as the left-hand-side variable: $\Delta y = y_{2004} - y_{1991}$. Prime-age death could have occurred at any point during the period spanned by the panel, from 1991 to 2004. The model looks as follows:

(1) $\Delta y_{ej} = \alpha + \beta_1 d_j + \beta_2 X_{ej} + \varepsilon_{ej}$.

X is the vector of control variables from the baseline round described in the previous section. This model is different from a first difference specification, as the independent variables are not differenced over time, while the outcome variable is. We adopt the specification presented above, which is akin to the empirical model used in Beegle *et al.* (2007), rather than a first difference specification because the changes in the explanatory variables and changes in the outcome y are likely to be jointly determined; thus including ΔX instead of X as explanatory variables could bias estimates of the effect of prime-age mortality.

3.1. Endogeneity issues

There are two possible sources of omitted variable bias after controlling for the observed baseline characteristics as described above: endogeneity with respect to deaths and with respect to living arrangements. Regarding the first issue, the presumption is that a significant portion of deaths are caused by AIDS, a disease typically contracted through distinct patterns of behavior in this setting (see, for example, Philipson and Posner, 1995). Certain individuals (and families) may be more likely to suffer an AIDS death. For example, poverty is often cited as a key driver of transmission of HIV/AIDS (Fenton 2004), although the evidence of this link tends to show the opposite association (as noted by Gillespie *et al.* 2007; Wojcicki 2005; Shelton *et al.* 2005; and Glick 2007). In their study of eight Sub-Saharan African countries, Mishra et al. (2007) find that wealthier adults are more likely to be infected with HIV, although this association is very weak after controlling for urban/rural residence and education. Other traits, such as risk aversion, may be inversely correlated with prime-age mortality. In turn, these household/family characteristics associated with prime-age mortality may also be correlated with our outcomes of interest. While we partially address this by including baseline (pre-death) covariates, we cannot entirely control for unobserved covariates which may bias the results.

One strategy to address the endogeneity caused by unobserved correlated behaviors, preferences, and discount factors within the household exploits the fact that most households branch out over the relatively long time span of the panel (see, for example, Beegle *et al*. 2007). Two individuals in the same household at baseline (in 1991) could split off into separate households at some point during the panel, and thus experience a different history of household mortality over the course of the panel's 13 year time span. Thus, if we condition on this "dynastic" (otherwise referred to as "initial household") fixed effect, we would be eliminating the correlated behavior and preferences of individuals within these initial households. We would identify the effects of adult death using variation in the history of mortality within dynasties/families. However, our sample of older individuals, unlike the sample of all household members in Beegle *et al*. (2007), is small, and thus the dynastic fixed effects model would lack statistical power. Among the 613 older adults we follow from baseline to 2004, only 274 of them are co-residing with at least one other older adult at baseline. Restricting the sample to these individuals would likely lead to selection bias: those individuals whose initial household structure permitted or required them to live together may react very differently to mortality shocks. Thus, we do not attempt to compare outcomes across members within the same dynasty/family; instead we partially address endogeneity by examining *changes* in outcomes of interest (Δy), which removes individual (and household) time-invariant effects.

The second source of endogeneity is choice of residence. The event of a death among household members is a reflection of household composition, which can be endogenous. Two pieces of evidence support this idea in the KHDS data. First, there is a high degree of change in household composition over time. Second, within the first 4 rounds (1991-1994) of the KHDS, about one-third of all adult deaths in the data are among people who move into the household within six months of dying. To the extent that individuals chose to live in households in response to illness or recent death, the event of death in their household is endogenous. In part, we rely on the length of the panel to address this concern. First, AIDS deaths (as well as other deaths caused by major illnesses in this region) are preceded by serious morbidities. In the KHDS baseline, on average, illness began 12 months before the event of a death. For the vast majority of the deaths in our sample, both the baseline and 2004 data are more than 1 year from the symptom onset and the death. So, the majority of these deaths had a preceding illness whose onset with respect to observed morbidities was after baseline. In that case, we do not expect that either the surviving older adult or the ill household member would have anticipated the future death with respect to 1991 living arrangements. Second, while there is evidence that adult children move back in with their parents when very ill and shortly before they pass, this type of death is largely eliminated from our sample or combined with deaths of other children regardless of co-residing with the parent at time of death (our third death indicator).

3.2. Attrition bias

As mentioned earlier, there is a great deal of attrition in the sample over the 13 years of the panel, as Table 1 shows. This attrition is almost wholly due to death (i.e., deaths of elderly individuals). Of the 1,060 potential elderly individuals in the first round of the survey (those individuals who were surveyed who would have been over the age of 50 in 2004), 403 (38%) had died by 2004, and only 44 (4%) were not located. Most of the deaths, 85%, were reported to be due to illness, rather than injury or accident. Among the 61% of deaths, the specific causes range from blood pressure, malaria, cancer, AIDS, tuberculosis, and unknown cause (each at about 10%). The median length of the illness that preceded death was 3 months, but the mean is much higher, about 17 months. The consequence of this attrition is that we estimate the impact of prime-age deaths on elderly outcomes using the remaining sample of older individuals who are still alive in the fifth round of the panel (2004). Attrition is, as expected, strongly correlated with age. Of the 1,060 baseline respondents in our sample, 24% of those under 50 years in 1991 were deceased by 2004, compared to 46% of those over 50 years.

Using this selected sample may lead us to incorrectly identify the effect of a prime-age death on an elderly individual. For example, if the older adults who are still alive in 2004 are healthier or more able to do physical work than the individuals who died, then the labor supply response of these individuals to an adult death may be very different than an older adult on average.

In our case, in which attrition in the elderly sample is primarily because of the death of elderly individuals, we would expect attrition to be driven by both observable and unobservable determinants. To correct for attrition bias due to selection on observables, we use a standard inverse probability weighting procedure (Wooldridge 2001). The procedure involves weighting regressions using probability weights estimated from an attrition probit model. In addition, attrition itself, since it is largely a function of survival is in some sense a welfare outcome.

We model attrition in the canonical way, as follows. The dependent variable, Δy_{ej}, is observed only if the individual is alive in the last round of the survey ($A_e = 1$). Then,

(2) $\Delta y_{ej} = \alpha + \beta_1 d_j + \beta_2 X_{ej} + \varepsilon_{ej}$ observed only if $A_e = 1$

(3) $A_e^* = \delta_0 + \delta_1 Z_{ej} + \upsilon_{ej}$

(4) $A_e = 1$ if $A_e^* \geq 0$

(5) $A_e = 0$ if $A_e^* < 0$.

We estimate the attrition equation by regressing the binary variable A_e on baseline determinants of attrition, including individual and household-level demographic and socioeconomic characteristics, as well as baseline health and labor variables (Z_{ej}). We report the results in Table 3. We then use the estimated coefficients to predict the probability of survival to the last round of the survey, and use this probability to construct attrition weights, which then weight the observations in our outcome regressions. While this procedure can address the attrition associated with baseline characteristics, it does not resolve the issue that the death of a prime-age adult in the household may in itself contribute to attrition through the outcomes we examine (labor and health). If the death of a household member after baseline results in the elderly individual working longer hours and having poorer health, these effects, in turn, may result in higher mortality rates for the elderly. Under this scenario, our findings on labor and health outcomes are then underestimates of the actual impacts of deaths. We partially address this issue by including mortality events during the first waves (1991 to early 1994).

Table 3 shows that attrition is correlated with age and gender of the elderly individual; older individuals and men are more likely to attrite from the sample. Widowed men are especially likely to die before 2004. The coefficients on the correlates of attrition are similar for women and men (columns 2 and 3). Finally, we see from the table that living in a household that experienced prime-age death of a previous household member does not affect probability of attrition (column 4). While there are some baseline characteristics associated with attrition, the weighted results below are not different from the un-weighted findings (results not presented).

4. Results

4.1. Labor outcomes and adult death

We first examine the labor outcome impacts of deaths between 1991 and 2004 of previous prime-age household members or of adult child living outside the household in baseline.[8] In all regressions, we control for baseline demographic and household

[8] In Tables 4-8, we split the death variables in various ways, but the low prevalence of death shocks limits the numbers of ways we can divide/interact the death covariates. For example, we cannot explore the

characteristics. Since farming is the main economic activity in the region and constitutes the greatest share of work time, we first focus on farm hours alone. The average change in weekly farm hours from 1991 to 2004 is small and negative, a decrease of about 1.3 hours, on average the elderly work about 15 farm hours per week worked in 2004 (Table 2). In Table 4a column 1, we report estimates of the impact of the composite death indicator on the change in farm hours from 1991 to 2004. When we control for covariates, older adults who had a death shock experience an increase of about 1.8 hours in the change in farm labor over time, though this coefficient is not significantly different from zero.

In Table 4a column 2, we split the death variable into its three constituent categories: death of a co-resident adult previous household member, death of a non-co-resident adult household member, and death of an adult child living outside the household. Again, we find no significant impact of any of the categories of adult death on labor hours for older individuals. In column 3 of Table 4a, we interact the three death variables with a dummy that equals 1 if the older individual is female. The results reveal an important gender dimension of the impact of adult mortality: the death of a co-resident adult PHHM (previous household member) is associated with an increase in labor for female elderly individuals, but not for males. For males, there is an increase in working hours with the death of non-co-resident adult PHHM but it is not statistically significant. The change in labor hours for those whose children living outside the household died is small and not statistically significant.

In Table 4b, we report results of regressions in which the two PHHM death categories have been further broken down by specified characteristics. Each column in Table 4b is a separate regression. Now instead of three main death categories, we have five. The data set does not allow us to perform the same breakdown for the children living outside the household death variable as for PHHMs. Each column (regression) in the table corresponds to a specified characteristic along which we have broken down the PHHM death variables.

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deaths of previous household members by age group, gender of older adult, and relationship of the deceased to the older adult.

In column 1, we examine whether the impact of adult death on labor outcomes for the elderly varies by the age of the deceased adult. We split (co-resident and non-co-resident) PHHM deaths into deaths of young (15-29 years) and not young (30-50 years) adults. The results show that the impact of adult death varies both by residence status and by the age of the deceased adult. For co-resident PHHM deaths, younger adult deaths are associated with greater increases in labor hours. The increase (5.5 hours) is statistically significant. The opposite is true for non-co-resident PHHM deaths: the death of older prime-age adults is associated with an increase of 8 farm hours. These results are consistent with the hypothesis that co-resident younger adults are providing more in-kind support to their elderly relatives through farm labor, while non-co-resident older adults are providing monetary support from outside the residence. Older adults adjust to each of these deaths with an increase in work burden.

In Table 4b column 2, we break the PHHM death variables into whether or not the deceased adult was the elderly respondent's own child. The coefficients reported in column 2 show a similar trend to the results in column 1 (and the same hypothesis above would be consistent), although the PHHM not living with the older adult is not statistically significant.

In column 3, we decompose the death variables by gender of the deceased adult. We find no statistically significant evidence that female deaths, for co-resident or non-co-resident PHHM adults, are associated with different changes in farm labor hours for elderly respondents than male deaths. However, the size of the increase in work (although statistically not significant) for females co-resident deaths is similar to that of the male non-resident deaths (about 3 more hours per week). Again, this is suggestive that the contribution of these prime-age persons before their death to the economy of the household of older adults is in-kind (labor-sharing) in the case of co-resident females other support for non-resident males.

In the last column in Table 4b, we break down the PHHM death variables by spousal status. Since there are no instances of spouses who died aged 15-50 who were not living with the elderly individual at the time of death, this category is omitted from the regression. We find evidence that non-spouses' deaths are associated with bigger increases in labor hours than spouses regardless of living arrangement. In the case of co-resident deaths, this finding might be explained by the fact that co-resident own children and young adult deaths are associated with larger responses, and these categories of adults are mostly not spouses of the elderly respondent. In the case of non-co-resident deaths, we cannot compare the extent of the association for spouses versus non-spouses, since as mentioned above the variable for spouses is dropped in the regression.

The results in Table 4a and 4b for PHHM deaths hold if the deaths of children living outside are excluded. Together, the results of Table 4b suggest that support to the elderly from co-resident adults may be in the form of farm labor, and young adults and children of the elderly respondents may provide this support more intensively. On the other hand, non-co-resident support may be more intensively provided by older adults, whose deaths cause a greater increase in labor hours for elderly than non-co-resident young adults.

4.2. Impact of adult death on labor hours over time

Since the survey data also includes the year of death for previous household members who died, we can look at the dynamics of the impact of experiencing a prime-age death in the household over time. We divide the time span of the panel into three periods: 1991 to 1995, 1996 to 1999, and 2000 to 2004. We construct six dummy death variables, three corresponding to the deaths over time of co-resident PHHM adults, and three corresponding to the deaths over time of non-co-resident adults. These are not mutually exclusive categories, since the older adult may have had multiple death shocks across periods, and for co-resident as well as non-co-resident adult relatives. We also include the death of a child living elsewhere. Since we do not know the time of these non-co-resident children's deaths (denoted in the model below as CLE, or child living elsewhere), we cannot create the same, time-specific indicators as described above.

We denote co-resident PHHM deaths over time with "co" in the subscript, and non-co-resident deaths with "non-co" in the subscript. The new model we estimate is the following:

$$(6) \qquad \Delta y_{ej} = \alpha + \gamma_1 d_j^{91\text{-}95,co} + \gamma_2 d_j^{96\text{-}99,co} + \gamma_3 d_j^{00\text{-}04,co} + \gamma_1 d_j^{91\text{-}95,non\text{-}co} + \gamma_2 d_j^{96\text{-}99,non\text{-}co} + \gamma_3 d_j^{00\text{-}04,non\text{-}co} + \gamma_4 d_{ej}^{cle} + \beta_2 X_{ej} + \varepsilon_{ej}.$$

This model allows us to look at the impact of deaths that occurred 0-4 years ago, 5-8 years ago, and 9-13 years ago. We report the results in Table 5. The dependent variable is the same as in Table 4: the change in farm hours from 1991 to 2004. We report results from 4 regressions, each separated by the dotted line in the table. In these regressions, we examine the association of farm labor hours with adult deaths in the recent and more distant past. Estimating the extent of this association over time adds to our understanding of potential dynamics in the effects of adult mortality on the elderly. This aspect of our analysis is novel, and is made possible by the length of our panel data set.

The results of the first regression suggest a pattern over time in the association between farm labor hours and adult death. For co-resident prime-age adult deaths, this association is increasing (and measured more precisely as well) over time. There is no significant association between non-co-resident adult deaths and labor supply changes over time, but the standard errors are large for all three categories.

In the second regression, whose results are presented in the second set of rows in Table 5, we interacted the PHHM death variables with a dummy that equals 1 if the elderly respondent is female. We find again that the association between co-resident deaths occurring in the more distant past, which we found in the first regression's results, is strongest for elderly women. On the other hand, elderly men are the ones whose labor supply appears to be most strongly tied to non-co-resident adult deaths, especially those occurring in the more distant past.

As in Table 4b, the gender of the deceased matters with respect to changes in farm hours (3rd regression of Table 5). We find that there are small and statistically insignificant impacts of a co-resident male adult death in the household, but the impact of co-resident female deaths is large and statistically associated with more distant death shocks. In the final regression reported in Table 5, we investigate how the effects of adult deaths over time vary by whether or not the deceased adult was the elderly respondent's own child. Co-resident deaths of own children are associated with increases in labor hours for deaths in the middle and more distant past categories, whereas co-resident deaths of adults who were not the children of the elderly are associated with increases in labor but only for the most distant past category (9 to 13 years past). For the non-co-resident PHHMs, a pattern is difficult to discern with the largely imprecise estimates.

In Table 6, we report results for types of labor other than own farm hours. The other types of labor we focus on are chores (collecting firewood and water), non-farm self-employment, and wage employment. As Table 6 shows, deaths are not associated with changes in hours of any of these other activities, at least not with statistical significance. Some specific categories do show large magnitude in coefficients but with large standard errors (such as older adults wage employee hours given the death of a non co-resident PHHM between 1991 and 1995). In general, however, we conclude that older adults do not appear to be responding on labor margins other than farm labor, which accounts for more than 70% of total hours worked on average**.**

4.3. Asset buffering and the response of labor hours

While we find that older adults are working more when experiencing a death in the household, this increase depends on the gender of the older adult and the co-residency with the deceased at the time of the death. Moreover, we see this increase mainly for deaths occurring in the more distant past. In this section, we present evidence that older adults use asset positions to buffer the labor impact of adult death in their households. We interact the death indicator variables with baseline asset values for livestock, total physical stock, and the household's dwelling, as well as acres of land owned by the household. If assets serve to buffer the impact on farm labor supply, then we should see a negative coefficient on the interaction term: labor hours increase more in households with fewer assets. Our asset measures are reported at the household level. The survey did not ask about which individuals held ownership over the asset.

In Table 7 we find that only livestock significantly buffers the labor response, and this impact of mainly for deaths of co-resident adults. To interpret the coefficients from column 1 of Table 7, we note that ordered in terms of value of livestock at baseline, the 25th percentile of households had 0 livestock value, while the 75th percentile of the same distribution owned about 8 USD of livestock. Thus, going from the 25th to the 75th percentile of the livestock value distribution decreases the labor supply response to co-resident adult death from 4.06 to 3.04, which is a reduction of 0.96 hours, or about 24 percent. In contrast, we find small and insignificant coefficients on the interactions with the value of physical stock and household dwelling, and acres of land. We might expect that livestock value exhibits the greatest buffering behavior, since livestock is a liquid asset, as compared with land holdings, owned dwellings, and other forms of assets. These results suggest that older adults, where they have livestock, can use it to compensate for having to work more in the face of a death shock.

4.4. Results for health indicators

The focus thus far has been on the burden of prime-age mortality on older adults with respect to having to work more hours. In this section, we extend the focus to look at various measures of well-being, mainly individual health indicators and household food consumption. Our health indicators are BMI, acute illness, chronic illness, days of restricted activity and days of no activity. We report the results in Table 8. Changes in BMI over the course of the panel are not significantly different for elderly individuals experiencing adult death in their households or among their non-resident biological children (column 1). This lack of response holds for other health indicators as well, namely chronic illness, and days of restricted and no activity (columns 4, 5 and 6). These results are consistent with prior work with the short run panel from the same data set. Ainsworth and Dayton (2003) find--using the first four years of the same panel--that elderly individuals' BMI returns to its original level within one year of an adult death.

On the other hand, column 2 of Table 8 shows that per capita consumption of the household is actually significantly greater for individuals experiencing a co-resident death in the near past (0-4 years ago). One possible explanation for this finding is that care giving to co-resident adults may have been drawing away funds from the elderly individual's own consumption, especially when the adult is very sick. When death in the household occurs, consumption of older adults may actually increase in the short run, due to the freeing up of these resources. An alternative explanation is that there is surplus labor.

Column 3 reports results for changes in acute illness status. We find that both co-resident and non-co-resident adult deaths are associated with increases in the probability of acute illness for deaths occurring in the more distant past. This finding seems to concur with the evidence discussed earlier that the labor supply response to adult death increases over time, and may manifest itself in increases in acute illnesses.

Apart from the acute illness results, we find no evidence that the deaths of non-co-resident adults or children living outside the household impact health or food consumption. We discuss this result further in the following section.

5. Conclusion

HIV/AIDS is drastically changing the demographic landscape in high-prevalence countries in Africa. Increases in prime-age mortality rates have resulted in “missing” working-age adults, which has implications on the well-being of surviving family members. This study focuses on one specific category, older adults, who may be especially vulnerable. This demographic group often cares for orphaned grandchildren; they may rely on remittance and other in-kind support from their adult children; and older women especially may have less secure rights to household assets when men die. The burden of deaths of household members and children may force older adults to work longer hours and suffer declines in well-being. Despite the potential pathways, few empirical studies explore these impacts.

We use panel data from Tanzania that spans 13 years to study the long-run impacts of prime-age mortality on older adults, paying attention to the gender dimension of mortality impacts. We find that adult death is associated with increased farm hours but this impact varies by the gender of the older adult and co-residency. Older women who suffer the loss of a co-resident member among their baseline household are working five hours more each week. For older men, we see a similar impact, although not statistically significant for deaths of non-resident members. These impacts are concentrated among the more distant death shocks—recent deaths are not associated with increases in labor supply. So even in regions with sharp declines in HIV prevalence, some groups, such as older women, may be vulnerable to death shocks as much as 13 years in the past.

As for health, we see few impacts associated with deaths of household members. Perhaps the most striking findings in this dimension are that adult deaths occurring in the recent past are associated with *increases* in *per capita* food consumption. The probability of acute illness decreases in the recent past, but subsequently rises for deaths in the farther past. Together, these findings suggest that, in the short term, older individuals in households with adult death may actually be better off, due to a decreased burden of care for the deceased individual before time of death. However, in the longer term, farm work increases significantly, and we find some evidence for declines in health as well. Even in settings where HIV prevalence is low today, high rates in the past (in this context, the early 1990s) have a lingering impact of the situation of older individuals. Policies which help ensure complete markets for livestock and other forms of assets, provide asset accumulation, and preserve women's rights to property may help mitigate the long-run negative impact of prime-age deaths.

The death of a non-resident biological adult child is not associated with more work or poorer health among older adults. We do not have direct measures of the extent to which adult children support their parents who live in another household, either through cash or in-kind assistance. These results suggest that either this support is replaced by other family members or the support is much lower than is currently speculated. In their cross-country study of income sources, Carletto *et al.* (2007) find that transfers (including remittances from relatives) constitute less than 10% of total income in the set of African countries they examine. This is a much lower share than for other regions (East Asia, East/Central Europe and Latin America). Of course, it is possible that the share of income from remittances is much higher for particular subgroups of households, and non-income support (labor-sharing) may be important too. We also note, though, that most of the older adults in the sample reside with at least one prime-age adult (Table 2). This decreases slightly by 2004, but still fully three-quarters reside with a working-age adult. We do not examine the sub-sample of older adults with no prime-age adult in the household, since the sample is too small, but this may be the group for whom the death of an adult child does impact on working hours and health.

While this study contributes to a more complete picture of the impact of prime-age mortality on older surviving adults by focusing on work burden and health, the findings should be caveated by concerns of endogeneity. The main driver of prime-age adult mortality, HIV/AIDS, is associated with behaviors that call into question a causal interpretation of our findings. Short of experimental options to study the impact of adult mortality[9], we partially address this, exploiting the baseline characteristics as well as the time dimension which largely precludes anticipation of deaths based on morbidities. Also, other dimensions may be important, including power and bargaining dynamics within the household and the mental health of the elderly. While we do not study these changes in this paper (partly due to data limitations), they are important topics for future research.

[9] An alternative to measuring the consequences of death shocks would be to study the impact of an averted mortality. Drawing on a sample of HIV-infected households under ARV treatment, Goldstein et al. (2008) take this approach in work from Kenya to assess the impact of ARV treatment on improved health and changes in labor outcomes. However, these results speak to the economic impact of morbidity among household members, and not the impact of death which may be quite different.

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Table 1: 2004 Elderly Sample, Re-interview status and Living Arrangements

Panel A: **Result of 2004 interview**		
Re-interviewed	613	(58%)
Deceased	403	(38%)
Not located	44	(4%)

Panel B: **Living arrangements of sample**

	Baseline			**2004**
	All (N=1,060)	**Subset that died or were untraced (N=447)**	**Subset re-interviewed (N=613)**	**(N=613)**
Widowed	26.9%	34.7%	21.2%	38.5%
Household size	6.7	6.1	7.0	5.1
No other household members	2.5%	3.1%	2.0%	7.0%
Any prime-age adult (age 16-49 years) in household (excluding self)	82.8%	79.2%	85.5%	78.0%
Any minor (age 0-15 years) in household	85.8%	80.3%	89.9%	73.6%
Relationship to head				
Head	58.9%	60.1%	55.8%	74.1%
Spouse	23.5%	14.8%	29.9%	17.9%
Father/mother	8.2%	10.5%	6.5%	4.9%
Other relative	9.4%	11.6%	7.8%	3.1%
Living with a grandchild	34.3%	36.0%	33.1%	54.3%

Note: Living with a grandchild is inferred based on being the head and at least one child in the household being the grandchild of the head, or being the parent of the head and a child of the head residing in the household. Child refers to a biological child of the respondent (not simply a co-resident minor).

Table 2: Summary Statistics for 2004 Sample of Older Individuals

	(1)	(2)	(3)	(4)
		Re-interviewed in 2004		
	All	All	No death	Any death
Female (%)	0.54	0.59*	0.55	.64*
Education (highest grade completed)	2.75	2.84	2.84	2.83
	(2.91)	(2.87)	(2.85)	(2.92)
Age at baseline	56.34	52.49*	52.08	53.25
	(13.12)	(10.14)	(10.42)	(9.91)
Baseline				
Farm hours	14.74	16.66*	17.56	14.92*
	(13.28)	(13.50)	(13.58)	(13.21)
Hours collecting firewood and water	2.12	2.28	2.50	1.85*
	(4.14)	(4.19)	(4.48)	(3.53)
Wage employment hours	4.10	3.95	3.27	5.25*
	(12.91)	(12.62)	(10.90)	(15.34)
Self-employment, non-farm hours	1.86	1.65	1.30	2.33
	(8.56)	(7.63)	(6.34)	(9.61)
Body Mass Index	20.48	20.77*	20.69	20.92
	(3.09)	(3.08)	(3.12)	(2.99)
Acute illness (%)	0.56	0.51*	0.51	0.52
Chronic illness (%)	0.43	0.38*	0.38	0.38
2004				
Farm hours		15.32	15.29	15.39
		(14.40)	(14.47)	(14.44)
Hours collecting firewood and water		1.46	1.47	1.43
		(3.27)	(3.06)	(3.65)
Wage employment hours		2.72	2.66	2.82
		(12.07)	(12.08)	(12.09)
Self-employment, non-farm hours		1.99	1.55	2.82
		(9.51)	(7.69)	(12.22)
Body Mass Index		20.36	20.04	20.96*
		(3.07)	(3.00)	(3.13)
Acute illness (%)		0.65	0.65	0.65
Chronic illness (%)		0.53	0.51	0.56
Co-resident PHHM who died from ages 15-50				
1991-1995		0.09		
1996-1999		0.07		
2000-2004		0.10		
Non-co-resident PHHM who died from ages 15-50				
1991-1995		0.02		
1996-1999		0.04		
2000-2004		0.05		
Child living outside HH aged 15-50 (in 1991) who died		0.13		
Number of observations	1,060	613	402	211

Note: Statistically significant differences between columns 1 and 2, and columns 3 and 4 are indicated by * at 5%. Hours refer to hours in the last 7 days. Standard errors are in parentheses. PHHM is a "previous household member" residing with the older adult at time of death.

Table 3: Baseline Correlates of Attrition

Dependent variable is indicator for alive in 2004

	(1)	(2)	(3)	(4)
Sample:	All	Women	Men	All
Female	0.214**			0.215**
	(0.105)			(0.106)
Living with PHHM who died from ages 15-50 between 1991 & 1994				-0.005
				(0.244)
Education (highest grade completed)	-0.017	-0.008	-0.014	-0.017
	(0.019)	(0.029)	(0.026)	(0.019)
Age (/10)	1.265***	1.407***	1.357**	1.265***
	(0.334)	(0.462)	(0.554)	(0.334)
Age squared (/100)	-0.137***	-0.146***	-0.150***	-0.137***
	(0.029)	(0.040)	(0.048)	(0.029)
Baseline widow status	-0.150	-0.055	-0.356	-0.150
	(0.111)	(0.130)	(0.230)	(0.110)
Health				
Body mass index	0.015**	0.018**	0.010	0.015**
	(0.007)	(0.009)	(0.011)	(0.007)
Illness > 6 months	-0.119	0.004	-0.339**	-0.119
	(0.091)	(0.126)	(0.140)	(0.091)
Ill in the past 4 weeks	-0.097	-0.139	0.043	-0.096
	(0.097)	(0.135)	(0.142)	(0.097)
Days of no activity	-0.046	-0.110**	0.034	-0.046
	(0.039)	(0.054)	(0.063)	(0.039)
Days of restricted activity	-0.010	0.059	-0.085*	-0.010
	(0.033)	(0.049)	(0.052)	(0.033)
Labor supply: hours last week				
Farm	0.004	0.000	0.009	0.004
	(0.004)	(0.005)	(0.006)	(0.004)
Collecting firewood and water	-0.008	0.006	-0.033*	-0.008
	(0.010)	(0.013)	(0.019)	(0.010)
Wage employment	-0.004	0.005	-0.007*	-0.004
	(0.003)	(0.011)	(0.004)	(0.003)
Self-employment, non-farm	-0.009*	-0.017**	-0.005	-0.009*
	(0.005)	(0.008)	(0.008)	(0.005)
Value of assets at baseline				
Business	-0.209	-0.320	-0.103	-0.209
	(0.138)	(0.260)	(0.109)	(0.139)
Durable goods	0.008	0.043	-0.018	0.008
	(0.011)	(0.027)	(0.023)	(0.011)
Farm equipment	0.223	0.056	0.242	0.223

Table 3: Baseline Correlates of Attrition

Dependent variable is indicator for alive in 2004

	(1)	(2)	(3)	(4)
Sample:	All	Women	Men	All
	(0.204)	(0.402)	(0.181)	(0.204)
Farm buildings	0.509	-0.936	1.917*	0.509
	(0.424)	(0.924)	(1.083)	(0.423)
Livestock	-0.059	-0.105*	0.092	-0.059
	(0.043)	(0.058)	(0.113)	(0.043)
Owned dwellings	0.002	0.017	-0.008	0.002
	(0.017)	(0.025)	(0.024)	(0.017)
Un-owned dwellings	-0.023	-0.022**	-0.041	-0.023
	(0.015)	(0.010)	(0.062)	(0.015)
Land	0.019*	0.036**	-0.002	0.019*
	(0.010)	(0.015)	(0.013)	(0.010)
Number of observations	1,049	575	474	1,049

Notes: Results of probit model reported; robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Includes controls for sample enumeration area classification. Excludes 11 observations missing information on assets. PHHM is a "previous household member" residing with the older adult at time of death.

Table 4a: Impact of Adult Death on Own Farm Labor Hours in Past 7 Days

Dependent variable is (Farm hours last week 2004 – Farm hours last week 1991)

	(1)	(2)	(3)
PHHM who died ages 15-50 *or* child living outside HH died ages 15-50	1.745 (1.696)		
Co-resident PHHM who died ages 15-50		2.760 (1.795)	-0.449 (2.602)
…interacted with female indicator			5.232 (3.196)
Non-co-resident PHHM who died ages 15-50		2.859 (2.839)	5.856 (3.654)
…interacted with female indicator			-4.901 (4.987)
Child living outside HH aged 15-50 (in 1991) who died		-1.187 (2.462)	-1.604 (2.483)
Number of observations	561	561	561

Notes: PHHM is a "previous household member". Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, seasons of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004.

Table 4b: Impact of Adult Death on Own Farm Labor Hours in Past 7 Days, By Characteristics of Deceased Adults

Dependent variable is (Farm hours last week 2004 – Farm hours last week 1991)

Characteristic of deceased adult:	(1) Young adult (ages 15-29)	(2) Child of elderly individual	(3) Female adult	(4) Spouse of elderly individual
Co-resident PHHM who died ages 15-50, having specified characteristic	5.516** (2.348)	3.776* (2.284)	3.160 (2.270)	-1.305 (3.700)
Co-resident PHHM who died ages 15-50, NOT having specified characteristic	1.170 (2.090)	1.414 (2.168)	1.849 (2.329)	4.201 (2.595)
Non-co-resident PHHM who died ages 15-50, having specified characteristic	-3.609 (3.291)	0.861 (3.891)	0.797 (3.021)	-
Non-co-resident PHHM who died ages 15-50, NOT having specified characteristic	7.966** (3.253)	3.373 (3.384)	3.685 (4.639)	4.492 (3.557)
Child living outside HH aged 15-50 (in 1991) who died	-1.788 (2.401)	-1.318 (2.473)	-1.340 (2.491)	-1.561 (3.552)
Number of observations	561	561	561	561

Notes: PHHM is a "previous household member". There are no instances of PHHM who died ages 15-50 while not living with the elderly respondent who were the spouse of the elderly individual; thus, this variable is dropped in column 4. Robust standard errors in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, seasons of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004.

Table 5: The Impact of Adult Death on Hours Spent on Own Farm by Number of Years since Death

Dependent variable in all columns is (Farm hours last week 2004 – Farm hours last week 1991)

	Year in which death occurred:		
	1991-1995	1996-1999	2000-2004
Co-resident PHHM who died from ages 15-50	5.864**	2.817	-0.984
	(2.852)	(2.498)	(2.397)
Non-co-resident PHHM who died from ages 15-50	-6.228	4.669	3.249
	(4.560)	(4.548)	(3.175)
Co-resident PHHM who died from ages 15-50	-0.926	3.223	-1.289
	(4.661)	(4.071)	(3.721)
…interaction with female indicator	11.254**	-0.457	0.602
	(4.893)	(4.988)	(3.952)
Non-co-resident PHHM who died from ages 15-50	3.485	7.361	5.865
	(3.957)	(7.296)	(4.655)
…interaction with female indicator	-12.879**	-4.176	-5.816
	(5.287)	(8.371)	(6.065)
Co-resident female PHHM who died from ages 15-50	11.246***	1.482	-2.879
	(3.345)	(3.489)	(2.772)
Co-resident male PHHM who died from ages 15-50	0.512	2.677	2.312
	(3.836)	(3.432)	(3.864)
Non-co-resident female PHHM who died from ages 15-50	-6.563	4.857	2.699
	(4.399)	(5.671)	(3.680)
Non-co-resident male PHHM who died from ages 15-50	-5.020	4.714	0.946
	(12.421)	(7.383)	(4.018)
Co-resident own child PHHM who died from ages 15-50	3.743	5.339*	-1.335
	(3.495)	(2.909)	(3.808)
Co-resident non-own child PHHM who died from ages 15-50	9.238***	-0.871	-1.316
	(3.515)	(3.523)	(2.939)
Non-co-resident own child PHHM who died from ages 15-50	-12.961	3.325	4.605
	(7.947)	(6.998)	(4.412)
Non-co-resident non-own child PHHM who died ages 15-50	-1.286	5.494	4.467
	(4.603)	(5.799)	(4.364)

Notes: The table presents results from 4 separate regressions, each divided by the dotted line. PHHM is a "previous household member". Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, seasons of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004. The number of observations in each regression is 561.

Table 6: The Impact of Adult Death on Labor Hours

	(1)	(2)	(3)	(4)
Dependent variable:	Change in total hours	Change in chore hours	Change in self-empl hours	Change in empl hours
Co-resident PHHM who died ages 15-50				
1991-1995	3.628	0.835	0.455	-0.833
	(3.222)	(0.534)	(1.008)	(1.316)
1996-1999	1.785	0.989	-0.544	-2.616
	(3.905)	(0.647)	(0.927)	(1.804)
2000-2004	0.126	-0.202	0.090	0.684
	(2.966)	(0.478)	(0.927)	(0.697)
Non-co-resident PHHM who died ages 15-50				
1991-1995	-9.916	-0.878	-0.480	-6.286
	(9.490)	(1.223)	(0.828)	(4.108)
1996-1999	4.586	-0.647	-0.073	0.141
	(5.394)	(0.957)	(1.777)	(1.170)
2000-2004	5.364	0.294	-0.308	-0.488
	(4.389)	(0.536)	(0.418)	(1.280)
Child living outside HH aged 15-50 (in 1991) who died	-0.429	0.225	0.138	-0.788
	(2.968)	(0.619)	(0.614)	(0.890)
Number of observations	566	563	566	565

Notes: PHHM is a "previous household member". Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, seasons of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004.

Table 7: Asset Buffering and the Impact of Adult Death on Farm Hours

Dependent variable is (Farm hours last week 2004 – Farm hours last week 1991)

	(1)	(2)	(3)	(4)
Living with PHHM who died from ages 15-50	3.980**	4.774*	2.746	2.296
	(1.870)	(2.464)	(2.100)	(2.644)
NOT living with PHHM who died from ages 15-50	3.262	2.391	2.372	4.097
	(2.794)	(3.129)	(2.966)	(3.860)
Co-resident PHHM who died ages 15-50 interacted with:				
Value of livestock at baseline	-12.419***			
	(4.567)			
Value of physical stock at baseline		-0.622		
		(0.610)		
Value of owned dwelling at baseline			0.014	
			(1.448)	
Acres of land owned at baseline				0.074
				(0.378)
Non-co-resident PHHM who died ages 15-50 interacted with:				
Value of livestock at baseline	-7.152			
	(5.317)			
Value of physical stock at baseline		-0.021		
		(0.418)		
Value of owned dwelling at baseline			0.743	
			(1.184)	
Acres of land owned at baseline				-0.236
				(0.422)
Child living outside HH aged 15-50 (in 1991) who died	-2.085	-1.798	-1.174	-0.296
	(2.596)	(2.655)	(2.509)	(3.092)
Number of observations	561	550	561	561

Notes: PHHM is "previous household member". Interactions of asset variables with child living outside HH are included in regressions, but coefficients are not reported. Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, season of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004.

Table 8: The Impact of Adult Death on Health Outcomes by Years since Death

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in BMI	Change in ln(food consumption per adult equivalent)	Change in acute illness status	Change in chronic illness status	Change in days restricted activity	Change in days no activity
Co-resident PHHM who died ages 15-50						
1991-1995	1.332	0.145	0.139*	-0.071	-0.093	-0.143
	(1.546)	(0.117)	(0.078)	(0.095)	(0.380)	(0.327)
1996-1999	0.644	-0.034	-0.141	-0.052	-0.266	-0.171
	(1.166)	(0.140)	(0.091)	(0.123)	(0.442)	(0.349)
2000-2004	0.753	0.381***	-0.020	-0.061	0.464	-0.003
	(0.924)	(0.111)	(0.095)	(0.081)	(0.427)	(0.339)
Non-co-resident PHHM who died ages 15-50						
1991-1995	-1.414	-0.054	0.354***	0.157	0.465	0.399
	(2.710)	(0.258)	(0.070)	(0.207)	(1.168)	(0.423)
1996-1999	0.089	0.205	-0.112	0.076	0.789	0.169
	(2.449)	(0.158)	(0.119)	(0.139)	(0.576)	(0.567)
2000-2004	0.499	0.047	0.043	-0.002	0.144	-0.184
	(2.478)	(0.165)	(0.078)	(0.107)	(0.453)	(0.307)
Child living outside HH aged 15-50 (in 1991) who died	-0.722 (0.997)	-0.162 (0.106)	-0.042 (0.067)	-0.050 (0.091)	0.295 (0.353)	0.220 (0.297)
Number of observations	564	551	577	577	549	552

Notes: PHHM is a "previous household member". Robust standard errors are in parentheses. * significant at 10%, ** significant at 5%, *** significant at 1 %. Observations are weighted using inverse probability weights (based on Table 3, discussed in the text). Includes controls from baseline for gender, age and age squared, education, number of children 15-50 living outside household, seasons of interview, asset values, household size, and sample enumeration area classification. Also included are illness and crop shock variables between baseline and 2004.